THESIS for the DEGREE of M.D.

INTRA-OCULAR INJECTIONS

AN EXPERIMENTAL STUDY

by

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HISTORICAL RETROSPECT.

The successful treatment of detachment of the retina by means of intra-ocular injections has been one of the latest achievements of ophthalmic surgery. Professor Schoeler [1], whilst experimenting with cases of artificially produced panophthalmitis in rabbits, observed that tincture of iodine re-acted feebly when introduced into the vitreous. Knowing well its powerful antiseptic properties, he thought he had found an excellent remedy for cases of detachment of the retina, seeing that he could produce by it a slight adhesive retinitis without impairing the function of the retina. Accordingly at the first opportunity that presented itself he put his observation to a practical test. In 1889 a woman came to his clinic with an extensive detachment of retina the only part attached being a small piece below. Having obtained her permission he injected six drops of tincture of iodine successfully into the vitreous the woman ultimately regaining vision to $\frac{1}{7}$th.

The /

The following paper is the direct outcome of Schoeler's observation. It is a detailed account of fifty experiments that I performed in the Laboratory of the College of Physicians, Edinburgh. Instead of limiting my experiments like Schoeler to the action of tincture of iodine in cases of detachment of the retina, I followed a plan suggested to me by Mr George Berry, namely, to study the mode of action and the effect of various antiseptic solutions when introduced into the vitreous. The subject so far as I have been able to find out has not been worked at before hence the scanty references to literature contained in this paper. My object in performing these experiments has been

Firstly, to determine how far intra-ocular injections are possible.

Secondly, to test their antiseptic value in the vitreous chamber.

Thirdly, to describe in a systematic manner the ophthalmoscopic and microscopic changes produced.

Fourthly,/

Fourthly, to see, if in cases of detachment of the retina one could bring about the re-absorption of the subretinal fluid with consequent re-apposition of the retina to the choroid.

Before, however, beginning to portray to you my own experiments allow me in this early stage of the paper to give you a short historical retrospect of the subject, so as to enable you to understand clearly, why and how intra-ocular injections came into use and how much Schoeler owed to the labours of his predecessors.

The initiative of the whole subject is undoubtedly due to James Ware, who in December 1804 led the way in this new field of intra-ocular therapeutics. He was the first to recognise detachment of the retina and to describe it correctly long before the invention of the ophthalmoscope. In his book entitled 'Chirurgical Observations Relative to the Eye, London 1805', he gives us a detailed and graphic account of how he came to diagnose this condition of the retina in the case of a woman Mrs W., who had suddenly lost the sight of her left eye and /

and how subsequently he was led to interfere surgically in the hope of curing the affection. As to Ware's priority I think there can be no doubt,— his first operation was performed in December 1804. But to quote his own words - He says on page 235 when describing the case of a man who had lost the sight of his left eye, "I observed that his blindness was neither preceded by, nor accompanied with either pain or inflammation". This patient shortly after succumbing to a stroke of apoplexy afforded Ware an opportunity of examining an eye in such a peculiar state of blindness. "In this instance", he continues, page 512, "a considerable quantity of a yellow coloured fluid as thin as water was accumulated between the choroid coat and retina, the retina itself being collapsed and resembling a cone of a white colour, the apex of which was at the entrance of the optic nerve and its basis surrounding the crystalline humour". In December 1804 Mrs.W. presented herself with an identical condition. Influenced by a recollection of this case it occurred /

occurred to him "that if the effused fluid could be discharged it might not improbably be a means of affording the patient relief". His operation consisted "simply in the introduction of a common spear-pointed couching needle through the tunica sclerotica a little further back than the part where it is usually introduced for the purpose of depressing a cataract. As soon as the instrument entered the eye, a yellow coloured fluid immediately escaped. A compress was bound upon it and the patient put to bed". She recovered her sight completely and Ware observes two months later that "there is scarcely any appearance of inflammation".

It will thus be seen that Ware was the first to interfere surgically with the retina and to him is therefore due the honour of having opened for science this new field of intra-ocular therapeutics. Believing that detachment of the retina was nothing else than a hydrops choroidae analogous to ascites and hydrocele he scrupulously followed the method of treatment then in vogue for those affections.

His /

His theory and his method of treatment held the ground till the year 1866. Unfortunately Ware's original tract appears to be very scarce now-a-days and the majority of Continental writers have obtained their information about Ware from a book published in London in 1814 entitled 'Remarks on the Ophthalmy, Mackenzie' who described Ware's method in vague and ambiguous terms. Thus Dr.Coppey(5) quoting Mackenzie says that Ware "recommande de se servir d'une aiguille cannelée . . ." and then goes on to mention as his own method "mais il vaut mieux ponctionner avec une large aiguille à cataracte " . . . which is nothing else than Ware's "spear-pointed cataract needle". Professor Schoeler (6) quoting the same authority changes his name from James to John Ware and he is now constantly being referred to by Continental writers as John Ware. In 1866 Fano (8) modified Ware's treatment, He combined "la ponction avec une injection irritante dans le sac, dans le but de provoquer une inflammation entre la rétine et la /

la choroide". It appears Fano never put his method into actual practice but in 1872 Galezowsky (9) following Fano's suggestion injected tincture of iodine between the retina and choroid but failed to cause adhesion between them. This method of treatment then fell into disrepute till Schoeler in 1889 with a slight modification once more brought it into use. How far this surgical interference with the retina has been successful the following collection of 106 cases will show you.

Reported by		Results.	
Higgens[33.]	5	none	cured.
Hirschberg[34.]	10	1	"
Abadie [46]	8	2	"
Lekarski [57]	15	3	"
Galezowsky[48]	68	11	"
Total	106	17	"

or about 16 p. c. of cures.

Now it is a well-known fact that about 10 p.c. of cases of detachment of the retina cure spontaneously so that the results recorded above are far from /

from being brilliant; besides in all these cases compresses, leeches, dorsal decubitus and other remedies had been had recourse to, so that it is difficult to decide how far their success was due to the operation and how far to the remedies employed.

Professor Schoeler believing in the theory of Heinrich Muller (12) that shrinkage of the vitreous and not Hydrops Choroidae is the real cause of detachment and that of Leber, (13) that pathological changes in the vitreous are the essence of detachment pushed his knife through the retina into the vitreous, at the same time injecting tincture of iodine in the hope of "tearing across all pulling fibres of the vitreous . . . and finally exerting a hygroscopic action through the retinal perforation".

He published five cases where he had tried this method.

CASE I was that of a woman with extensive detachment, a small section of the retina below being the /

the only piece in situ. He injected 6 drops of tincture of iodine. Two months after no trace of detachment could be discovered and her field of vision was greatly widened.

CASE II was that of a man with a large peripheral detachment. He injected 4 drops of tincture of iodine. His field of vision very much increased and complete re-apposition of the retina followed.

CASE III that of a woman with almost complete detachment. He injected 3 drops of tincture of iodine. Her field of vision increased but only partial attachment of retina followed, two small bands being still visible.

CASE IV was that of a man with detachment at lower quadrant. He injected two drops of tincture of iodine at first, which was repeated a second time. Complete apposition of retina with very good field.

CASE V. A man with complete upward detachment. He injected 4 drops of tincture of iodine. His /

His field of vision normal except a little downwards with re-apposition of retina to its bed.

These remarkably successful cases of Schoeler led others to try this new method of treatment. One of the first was Dr.Gelpke (15) who published the result of a case where he had tried Schoeler's method. The patient was a man aged 66 years with the nasal half of retina detached. After taking every antiseptic precaution he injected 3 drops of tincture of iodine. The patient had no sleep on the following night, and there was great congestion of the eyelids. Four days after he became highly feverish, groaning with pain. His cheek was beginning to show patches of gangrene. He became delirious, then fell into a somnolent state and died without regaining consciousness. The post mortem showed gangrene of eyelids with meningitis. The sinus cavernosus was filled with a blood clot. No mention is unfortunately made as to the state of the eye, it having been reserved for further examination. Since this fatal case has been published /

published 8 other unsuccessful cases, treated in a similar fashion, have been reported, but I have been unable to trace out the authors.

Professor Schoeler's method of treatment differed from Fano's modification of Ware's in this respect only - the former injected tincture of iodine into the vitreous, believing with Muller and Leber that it is the real cause of detachment, whilst the latter following Ware's theory injected tincture of iodine behind the retina between it and the choroid. The results obtained by this latter method I have already tabulated. It only remains for me to show you those obtained by Schoeler's method.

Reported by

Schoeler	5 cases	5 cured
Gelpke	1 "	1 death
Unknown	8 "	8 unsuccessful
Total	14 "	5 cured

or about 35 p.c. of cures

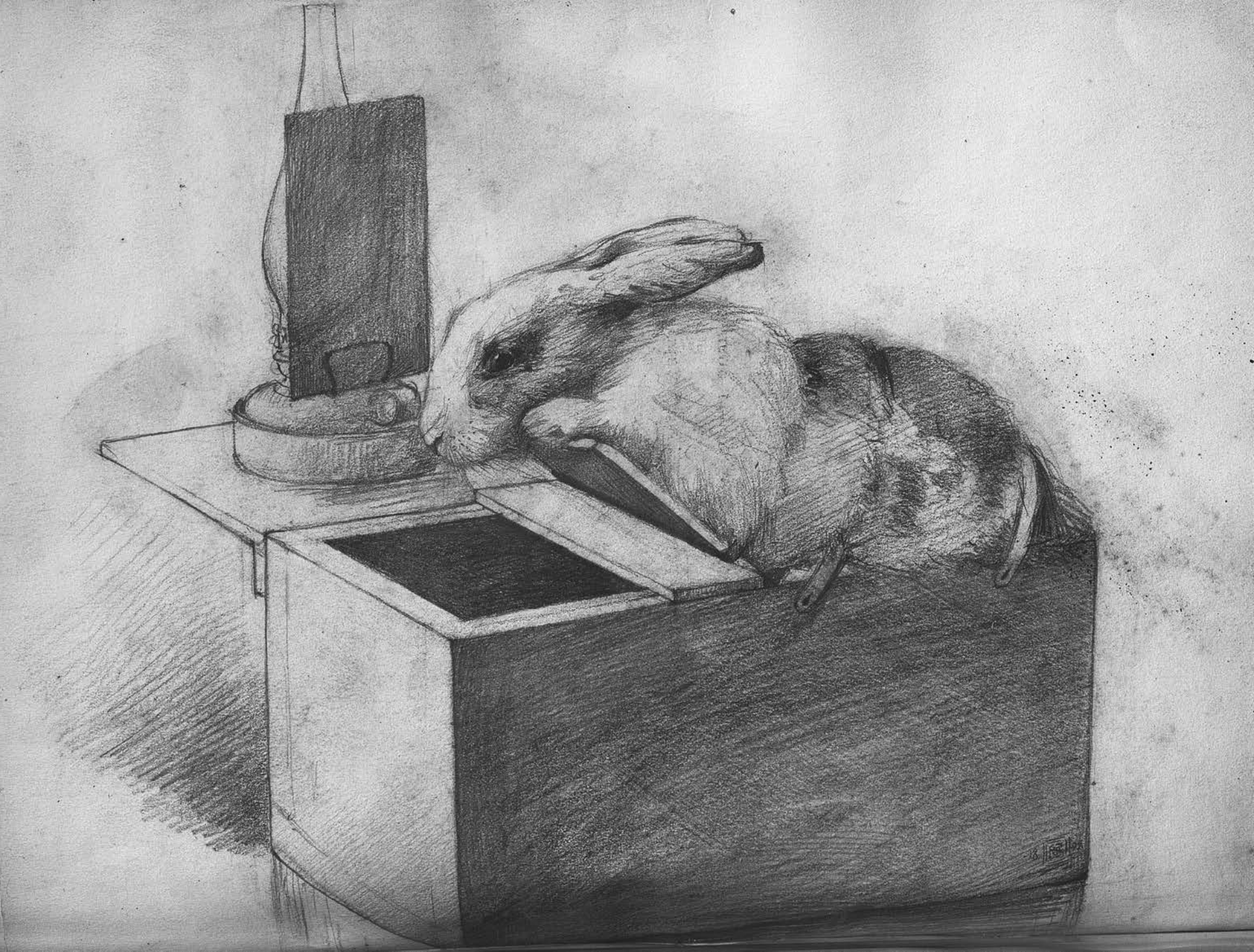
which you will see is a distinct improvement over previous /

previous methods.

In conclusion let me ask you to bear in mind not the results obtained, but the possibility of safely injecting into the vitreous certain chemical substances without interfering with the functions of the retina. Schoeler's procedure has been a great advance over former methods of medication, but unfortunately a patient having died whilst under treatment surgeons have naturally shrunk from using it. Still I hope that the day is not far distant when we shall be able by means of injections of various medicinal substances to treat many affections of the retina and choroid which seem to us at present almost incurable.

OPERATING METHODS USED.

Before beginning to give you a detailed account of my own researches it would, I think, avoid subsequent unnecessary repetition if I now describe the method and mode of operating which was followed throughout. At first I found it extremely difficult to make a satisfactory examination of the fundus without having an assistant to hold the rabbit in the various positions required. Even then the examination was cut short every few minutes by the struggles of the animal. After trying many ways to get over this difficulty, I devised the following simple contrivance which has answered my purpose better than I expected. It does away with the help of an assistant and unfetters both hands for other work. It consists of an oblong wooden box in which the animal is placed. The box has a movable inclined plane. This is fixed at any desired angle by means of a cross beam. The inclined plane should extend /



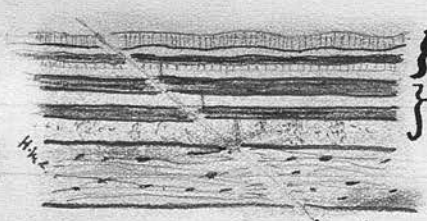
extend a little beyond the sides of the box, say about 4 inches, so as to leave the head of the animal entirely unsupported. The head would protrude beyond the inclined plane and thus one would be able to depress it or move it from side to side as the vertical or horizontal quadrants of the eye are being examined. In the box the animal lies in a semi-erect position its hind legs resting against the posterior side. It is strapped down to the inclined plane with 4 pieces of broad tape. It should be tied down pretty firmly so as to prevent it wriggling out, a very common occurrence at first. The head of the animal should be on a slightly higher level as it allows one to explore with greater ease the upper quadrant of the retina, the place chosen for the puncture of the hypodermic needle. The ophthalmoscopic lamp is placed on a small bracket fixed to the side of the box, it should be on a level with the animal's head and have a round flame of moderate intensity with a flat tin shade. I used a common hypodermic syringe graduated in cubic millimeters /

millimeters and having a fine needle for all my experiments. Schoeler uses one with a little knife at the end. It is undoubtedly easier to introduce, but the wound of the retina and vitreous is necessarily larger with it than with a fine hypodermic needle and thus there is more liability of subsequent septic injection. Previous to injecting, the conjunctival sac was invariably washed out with a solution of 1-1000 corrosive sublimate. The syringe was disinfected by placing it in boiling water, no antiseptics being used purposely in order to prevent any possible fallacy entering into the experiment. The injections were invariably introduced into the upper quadrant of the eye between the superior and the external recti muscles. I chose it in preference to any other part as it is so easily got at and the wound in the sclerotic not being a dependent point there is less liability of prolapse of vitreous. The injection again if introduced above percolates much sooner through the vitreous and exerts its action much more rapidly. The needle is introduced at first horizontally at a point not less than /

than 4 millimetres from the corneo-scleral margin. It is best to fix the eye with one hand with a small pair of fixation forceps, then with the other the hypodermic needle is to be pushed quickly through in a horizontal direction for $2\frac{1}{2}$-3 millimetres till all the coats of the eye have been pierced through. After the needle has penetrated into the vitreous the whole syringe is slightly tilted upwards; it is held firmly in that position while the injection is being made. This should be done as slowly and as gently as possible. The reason for the tilting of the syringe is to allow the point of the needle to occupy a vertical position in the vitreous so that the injection is made not directly on the retina but in close proximity to it; at the same time the injection is prevented by this means from running backwards along the tract of the needle and thus out of the eye. In withdrawing the needle pull it out as slowly as possible, preventing it moving to and fro as the hyaloid membranes get very much lacerated and cause subsequent opacities.

Sometimes /

Sometimes the needle gets caught in the sclerotic but by a screwing motion it is easily liberated. On no account make any jerking movements in withdrawing it. It is always better to have the eye of the needle pointing towards the retina otherwise if the injection is irritating or hygroscopic the lens rapidly becomes cloudy and makes any subsequent ophthalmoscopic examination very difficult and unsatisfactory. If the instrument has been introduced as directed the wound in the sclerotic would be necessarily oblique and would be closed



Diagrammatic representation of tract of hypodermic needle.

by the apposition to it of healthy choroid. Similarly the wound of the choroid would be closed by the contact to it of the uninjured retina. Thus, by this means any escape of vitreous is rendered impossible as theoretically the greater the tension within the eye the more firmly would the lips of the /

the wound be closed. At the point of puncture there is seldom any extravasation of blood but usually slight congestion occurs which disappears in a few days. It is advisable as soon as the injection is made to have an ophthalmoscopic examination to see if your needle has really penetrated into the vitreous. This seems absurd at first sight, but the sclerotic is so elastic and so hard to pierce that the needle is very apt to slip between it and the capsule of Tenon. Sometimes, especially if the needle is introduced very quickly, the retina is pushed in front of it and the injection made in the subretinal space. If the needle has penetrated through, a black triangular area is seen on ophthalmoscopic examination bounded by irregular margins. This traumatic coloboma persists throughout and is a valuable diagnostic. A few choroidal capillaries are usually seen at its margin and sometimes run through it presenting a very curious appearance. The retina, choroid and sclerotic become united together at point of puncture.

As /

As a general rule I injected about 2-4 millimetres this being on an average about $\frac{1}{5}$ of the entire capacity of the eye. I have found that with this amount I produced only transient glaucoma which lasted from 5-10 hours. The larger the amount of fluid injected the more persistent is the glaucoma; at the same time the subsequent inflammatory reaction is more powerful even with inert substances. I think the above quantity is quite sufficient for all practical purposes, if necessary it can be repeated at any time. As a general rule no dilatation of the pupil is required for ophthalmoscopic examination. The iris in the rabbit (7) contracts but feebly, allowing a fairly large pupil for ordinary examination. In some cases, however, especially in very young rabbits one requires to use a mydriatic. This animal, as is well known, is quite unaffected by poisonous doses of atropine, but singularly enough its pupil dilates perfectly well with very weak solutions of this drug. Duboisine I have found acts more powerfully and twice as quickly as atropine,/

atropine, but the dilatation produced is not so lasting. Homatropin and cocaine are weak mydriatics in rabbits. I have tried a 2 p.c. solution of hydrochlorate of hyoscine as recommended by Galezowski.(4) It produces a rapid and wide dilatation of the pupil, but unfortunately the opposite eye also participates in the dilatation and in many cases that is not a desirable thing.

The animal is at first dazzled by the light of the ophthalmoscopic mirror and after a few minutes seems as if hypnotised and remains perfectly motionless with fixed staring eyes so that, having once fixed the animal firmly to the inclined plane, the subsequent examinations are carried out without the least difficulty.

I feel that this chapter would be incomplete if I failed to give you a short description of the fundus seeing that I shall constantly be referring to it subsequently; it will at the same time make it easier for you to follow the changes produced in it by the injections. With the exception of

the /

the opaque optic nerve fibres and a few microscopic peculiarities of the retina, I have found very little else mentioned, by the numerous writers on comparative anatomy; yet I think the fundus of the rabbit is above all others one of the most interesting that I have examined. It seems to be a transition between the amphibian and mammalian types, the retina having no blood vessels of its own but receiving a few branches from the sub-hyaloid vessels. (10) The colour of the fundus varies just as it does in the human subject. In black rabbits it is of a chocolate colour, in albino and white it is of a rosy hue. Besides in albino the whole circulation of the choroid can be made out perfectly well.

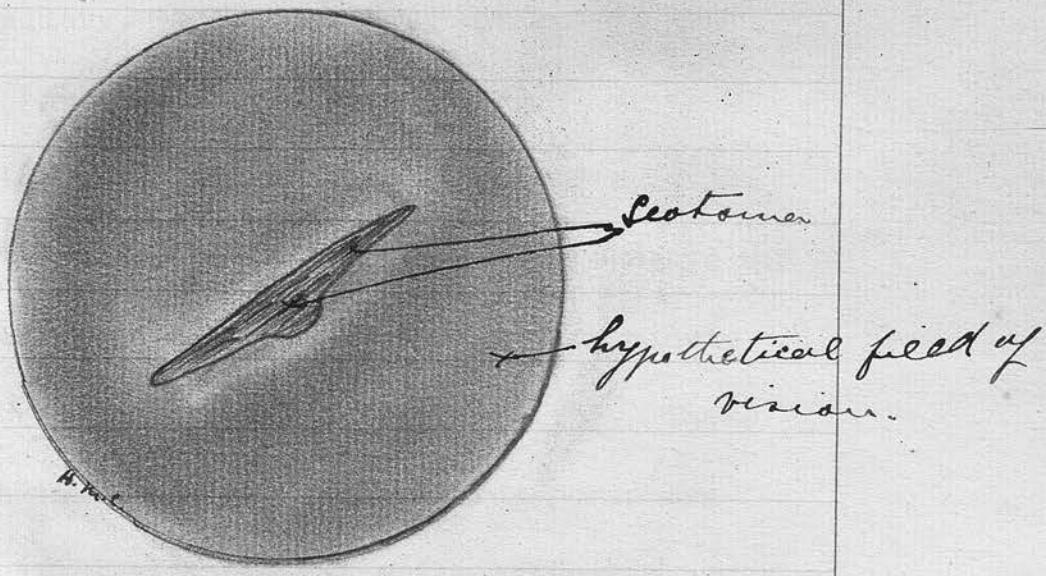
The optic nerve pierces the sclera above the horizontal meridian thus differing very materially from the condition seen in man. On entering it divides into four brush-like processes of a pearly whiteness. These are composed of nerve fibrils with their sheath of myeline.

Normal Fundus of Rabbit - (Black Rabbit)

The optic disc is oblong in shape, This is not due to the astigmatism present but seems to be the normal condition. Its long axis is not horizontal as at first sight appears but is inclined at an angle of 30º It is of a greyish rosy colour. Its border is well defined and stands out conspicuously from its surrounding fibres. The centre of the disc is snowy white and deeply excavated, thus cupping seems to be a normal condition in rabbits, the vessels /

vessels are seen to curve round its margin exactly as they do in cases of glaucoma in man. Radiating from the disc are the pearly white streamers of the optic fibrils. They proceed to periphery of the fundus in two broad bands, one on each side of disc and there end in fine brush-like processes. In addition to these lateral there are two smaller vertical bands of fibrils forming a white halo around the disc. Those on the lower surface are more numerous and coarser than the upper ones which are so fine and delicate as to be sometimes scarcely perceptible. The lateral bands are finely striated and give off numerous smaller fibrils as they travel towards the periphery. Those going to the lower quadrant are long, fine, and curve towards centre of fundus, on the other hand those going to the upper segment are short, thick, and stumpy, but also curve towards centre. All these fibrils have the same mode of origin. They spring by a thick short root which divides dichotomously, its branches finally ending in tufts. Judging from the extent and position of these fibrils the animal must have a considerable /

considerable central scotoma.



I have attempted above to represent it in a graphic manner following out the opaque portion of the retina. At each pole of the vertical axis of the disc will be seen a natural coloboma. It appears as a black triangular speck - that of the lower quadrant is the more prominent of the two; they are best seen in black rabbits.

The blood supply of the retina differs considerably as has been mentioned before, from the usual mammalian type and resembles very much that of the amphibians(19). There are two ophthalmic arteries. The external ophthalmic is the larger of the two and supplies /

supplies the choroid. It is a branch of the internal maxillary. - The internal ophthalmic, the smaller of the two, supplies the retina. It is a branch of the internal carotid. It divides in its turn into two branches (which lie in the sub-hyaloid space) a nasal and a temporal, each giving minute twigs to corresponding parts of the retina. These vessels run in a straight line towards periphery keeping parallel with the two white lateral bands of optic fibrils. All their branches run in the sub-hyaloid space and are thus superficial to the retina sending a few capillary twigs to supply it. These capillary branches are in the form of loops, the loops being thicker and more numerous towards the disc and gradually disappearing towards the periphery. They supply the nerve fibres and nerve cells and seem to end at the internal granular layers. This seems to be the rule in all mammalia. Dr T.W.Barrett,[21] who had examined the retinae of numerous mammalia but not that of rabbits, states that "in no case he had seen a vessel in the outer nuclear /

nuclear layer". The nasal and temporal branches run separately for a little distance and then divide into superior and inferior branches which give off numerous minute twigs that course between the fibrils and finally get lost in their tufts. These branches often entwine their neighbouring veins which are arranged in a precisely similar fashion as the arteries. There is great variety in the arrangement of the blood vessels but the one I have described above seems to be the most common. The blood vessels will thus be seen to be limited to a central strip of not more than an eighth of an inch in width, the rest of the retina being supplied by the fine capillary loops above mentioned. The whole circulation can thus be examined at a glance and the minutest subdivision of the vessels into their ultimate capillaries is plainly visible with the ophthalmoscope and in some cases the choroidal pigment, especially in black rabbits. I have chosen this animal for my experiments partly for the convenient size of its eyes and partly for the above peculiarities which allow one to study the smallest changes in the retinal circulation.

E X P E R I M E N T S.

In experimenting with medicinal substances on the vitreous, one is of necessity limited to the group of antiseptics. As these are more or less irritant in nature, they tend to produce an adhesive retinitis, and this will vary in intensity according to the irritant properties of the antiseptic. An ideal substance would be one, which, when injected in the vitreous would only cause slight retinitis with no subsequent impairment of vision, either by degeneration of retina or by leaving opacities in the vitreous. In selecting the following I have been guided partly by their common use in diseases of the eye and partly by their well-known antiseptic properties. So far as I have been able to find out, none have been injected /

injected in the vitreous before except tincture of Iodine by Professor Schoeler and corrosive Sublimate by Abadie[23].

The vehicles I used for the injections have been blood serum and distilled water both sterilized. Alcohol as a vehicle, in whatever strength used, is to be avoided as far as possible, as it is a powerful irritant by itself, and causes dense opacities in the vitreous which do not tend to clear up. It was Schoeler's vehicle in his experiments and an additional disturbing factor as will be shown later on.

Sterilized distilled water and blood serum when introduced aseptically into the vitreous are entirely passive in their action as the following experiments will show.

EXPERIMENTS with STERILIZED DISTILLED WATER.

Four cubic millimetres were injected into the vitreous /

vitreous of two grey rabbits. In both cases contraction of the pupil followed, with glaucoma, which completely disappeared four hours after, the eye regaining its normal tension. The retinal circulation was but little affected, the veins if anything, being rather more prominent than usual, the retina presented a normal appearance but the choroidal vessels remained congested for eight hours after.

The following picture taken from the fundus of one of the rabbits twenty-four hours after, will give you an idea of the state of matters.

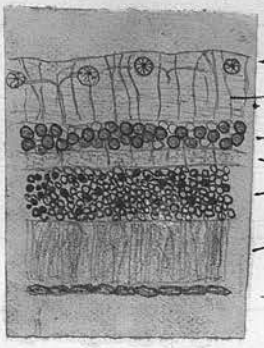
P = Point where the injection was made. Notice pigment of choroid.
V = Vessels normal in size.
O = Opaque fibres well seen
C = Colobomas.
d = Disc not congested but of a rosy colour.
a = capillaries normal in size.

After Distilled water.

You will notice that the vessels have regained their normal appearance. The disc is of a reddish grey colour and shows no sign of inflammation. The vitreous is clear, and the retina, except at the point of puncture shows nothing abnormal. At the point of puncture you will notice a pigmented patch. When the animal was killed a fortnight after, this pigmented area had considerably diminished. At this point some choroido-retinitis was present, the retina, choroid and sclera being firmly united together. This local choroido-retinitis occurs in every case of puncture of the retina and is not due to the injection of distilled water. It is the mode of healing of the retina, choroid and sclera.

The following taken from the eye of the other rabbit shows that no histological changes have occurred in the retina, beyond the point of puncture.

After Distilled water.



P x 600.

The nerve cells show no cloudy swelling and there is no infiltration of leucocytes in any of the 7 layers. The choroid and its vessels show no congestion, nor are any of the 3 layers of the eye united together.

Blood Serum has much the same effect as distilled water, but the glaucoma produced lasts only one or two hours.

EXPERIMENTS with a 30 p.c. SOLUTION of ALCOHOL.

Injected 4 c. mil. into the vitreous of a black rabbit. On examining immediately after, a faint haziness was seen to spread from the point where the injection was made. This increased gradually till nothing but a white reflex could be had from the fundus. On the following day the lens became opaque at its periphery /

periphery and at its centre, there being a clear ring between these two opacities, which gradually became invaded till the whole lens became cataractous. The glaucoma passed off on the second day. The blood-vessels were seen through the haziness to be congested. There occurred two large sub-hyaloid haemorrhages. One at the lower quadrant and the other almost at the origin of the artery. Besides these there were numerous minute capillary haemorrhages. With the ophthalmoscope one could see these small haemorrhages forming by the rupture of the engorged capillaries. A fortnight after the animal was killed.

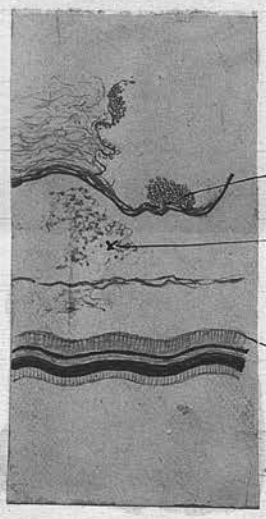
P = Point of puncture choroido retinitis.
H = haemorrhages sub-hyaloid.
c = small capillary haemorrhages.
d = optic disc congested
V = vessels dilated.

Action of alcohol.

The lens was found completely cataractous. There were numerous small opacities in the vitreous, which showed signs of clearing up a few days before the rabbit was killed.

Histologically the retina showed no signs of inflammatory re-action. In the vitreous there are numerous small haemorrhages and close to the retina you will notice a small cell infiltration with fine fibrin threads. This was the site of a small sub-hyaloid haemorrhage.

L. P. about x 50.



At the point of puncture there occurred choroido-retinitis with complete adhesion of all the coats of the eye, around it the retina was disorganised and infiltrated /

infiltrated with small round cells.

EXPERIMENTS with a 1-50 SOLUTION of CARBOLIC ACID.

Dr.Wicherkiewicz[25] in 1885 accidentally washed the anterior chamber after cataract extraction with a one per cent solution of carbolic acid instead of boracic acid. Having discovered his mistake he soon washed it out again with distilled water, but in spite of that a rapid inflammatory re-action followed, with haziness of the membrane of Descemet and with great chemosis of the conjunctiva and eyelids.

In rabbits when 4 c.mil. of 1-50 solution were introduced into the vitreous the same violent inflammatory re-action ensued. The pupil immediately contracted and remained so till the animal was killed a fortnight after. The vitreous became soon of a milky white colour. The blood vessels were intensely congested and there occurred a few small capillary haemorrhages /

haemorrhages. On the second day there was chemosis of the conjunctiva. The cornea had a ground glass appearance. On the iris there were numerous flakes of lymph. At the point of puncture there was a large extravasation of blood with oedema of the eyelids. On the fifth day the inflammation began to subside, the eye ultimately assumed a normal appearance. On ophthalmoscopic examination the congestion of the vessels had disappeared and was followed by contraction, the arteries being specially so affected. The fundus was of a dark red colour with patches of a chocolate colour the site of the haemorrhages. There was a

P = Point of puncture choroido-retinitis.

H = haemorrhages.

C = small capillary haemorrhages.

d = disc congested & its capillaries well seen.

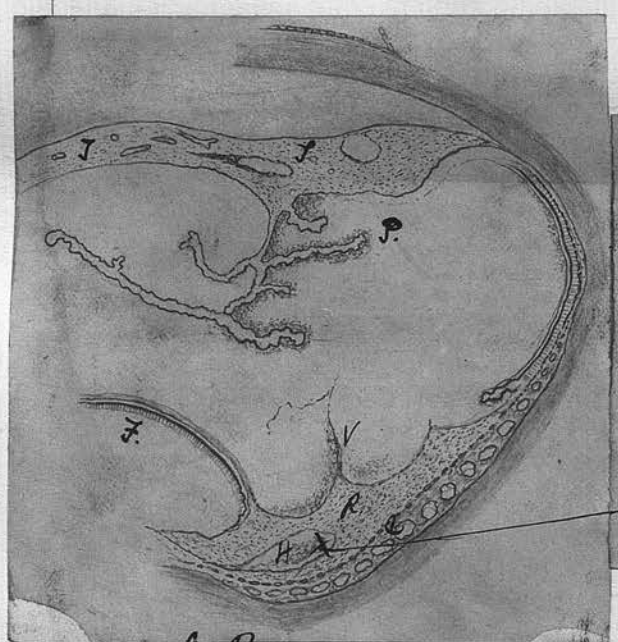
O = opaque fibres degenerating.

Action of Carbolic

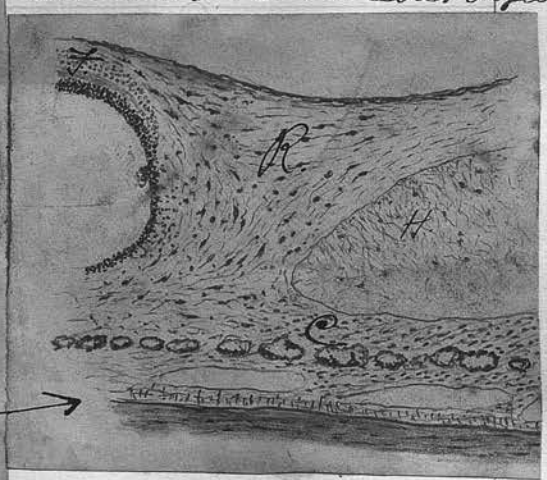
large triangular patch at the lower and outer quadrant which showed signs of absorption. The other haemorrhages were round and smaller and situated in a line parallel to the opaque optic nerve fibres. There were also a few recent capillary haemorrhages on the opaque fibres. The optic disc was of a pink colour with small capillaries coursing over it.

Histologically the retina showed at point of

I = Iris infiltrated with small round cells. R = Retina completely disorganised. C = choroid thickened with greatly dilated vessels. H = haemorrhage in retina. V = Vitreous organising.



L. P. x 50.



H. P. x 300.

P = ciliary processes thickened & invaded by leucocytes. F = Detached retina showing retinitis.

injection complete disorganisation. Further towards the ciliary margin the nerve cells had disappeared and the retina infiltrated by leucocytes. Haemorrhages in the disorganised part could be seen occupying as a rule the internal granular or the nerve cell layers. The choroid was enormously thickened and its vessels greatly dilated. The pigment in some places had completely disappeared; in some parts it could be seen in the form of fine granules whilst in other parts it surrounded the vessels. The vitreous is full of small cells. The iris shows distended vessels with a small cell exudation. The ciliary processes are thickened and congested. The epithelium of the cornea is cloudy.

In order to test its antiseptic power in the vitreous I injected again 4 c.mil. of a 1-50 solution. Immediately after, I introduced a drop of a solution containing the staphylococcus pyogenes as near the spot of /

of injection as was possible. On the second day suppuration in the vitreous had begun. The experiment was repeated again with the same result. A stronger solution of carbolic 1-20 stopped its growth for five days but then the inflammatory re-action produced by it was such, as to destroy completely all the nerve elements of the retina.

EXPERIMENTS with CORROSIVE SUBLIMATE.

Injected 4 cub. mil. of 1-5000 solution. The pupil immediately contracted and remained so for two days. The glaucoma lasted for 4 days disappearing with the inflammatory re-action. At point of puncture there occurred a slight extravasation of blood. On the second day acute conjunctivitis set in with excessive secretion of mucus, this passed off on the 6th day. On ophthalmoscopic examination there was a dense opacity in the vitreous close to point of injection /

injection. The retinal vessels were at first contracted but five hours after they were found dilated, and a few capillary haemorrhages were present close to the point of puncture. The choroidal vessels were enormously dilated and formed a series of ribs behind the retina. The optic disc was of a scarlet colour and its small capillaries were about twice their usual size. All inflammatory symptoms disappeared on the 7th day, but the vitreal opacities seemed to become denser every day.

A solution of 1-1000 produced a very violent inflammatory re-action, iritis and conjunctivitis with excessive secretion of mucus appeared 8 hours after. There was oedema of the eyelids. The pupil was pinpointed. On ophthalmoscopic examination a large retinal haemorrhage was seen to occupy the lower quadrant at the periphery, extending from the point of puncture to the haemorrhage was a dense white opacity.

All /

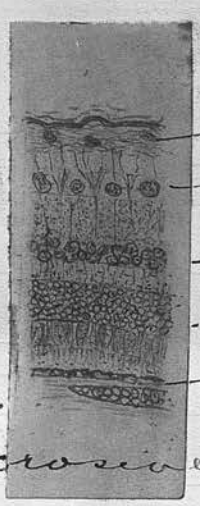
All round this the retina had a scarlet appearance. The disc was of a pinkish colour. A few small capillary haemorrhages were on the white opaque fibres.

P = Point of Puncture.
a = detached portion of Retina
H = haemorrhage.
e = capillary haemorrhage
o = degenerating optic nerve fibres.
d = Retinitis & great congestion of choroid

Action of corrosive Sublimate.

Histologically the ganglion cells are seen to be degenerated and atrophied, the rest of the retina is infiltrated with leucocytes. The choroid is thickened and its vessels dilated. There is union of the retina with choroid. The 1-5000 solution does not check the growth of pyogenes aureus, when injected it soon precipitates the albumen and forms a dense

coagulum /



A.P. x 800

M.

Corrosive Sublimate (1 – 8.000)

coagulum. It cannot thus penetrate very far into the vitreous. The 1-1000 though producing the same effect stops the growth of pyogenes for 5 days. In two cases out of six it stopped its growth entirely, but then the dense opacity left behind it rendered vision very doubtful. Abadie(26) reported a case of syphilitic choroiditis which had resisted all forms of treatment but which he had at last succeeded in curing by injecting, on several occasions, one drop of a solution of corrosive sublimate 1-1000. Unfortunately he does not give us what amount of vision the man had, nor the re-active inflammation which must have followed each injection.

EXPERIMENTS /

EXPERIMENTS with PYOKTANNIN.

As an antiseptic this substance has been used extensively. Stilling[27], Mauthner[28], Braunschweig[29], Petersen[30], Coppey[31], have used it with great success. It is claimed for it that it checks suppuration once it has begun; the only antiseptic known to do so according to Stilling. The latter injected a fluid containing the staphylococcus pyogenes into the anterior chamber which led to hypopyon keratitis. He then injected a solution of 1-5000 pyoktannin and this arrested the process completely. Seeing its powerful antiseptic properties, I injected 4 c. mil. of the above solution into the vitreous of a grey rabbit. There was no change in the size of the pupil and except the bluish tint imparted to the vitreous nothing of any consequence was noticed. Close to the point of injection I introduced a drop of a solution containing the staphylococcus pyogenes. On the /

the following morning the vitreous was one mass of pus. I then injected a solution of 1-1000, with the same result in two different rabbits, the growth of the staphylococcus not being checked in the least.

When pyoktannin is injected in the vitreous it is deposited in minute particles on the optic disc, retina and on the posterior surface of lens. When introduced into the centre of the vitreous chamber it rapidly passes forward and colours the posterior part of the lens and the ciliary processes. If introduced near the floor of the vitreous chamber it passes backwards and is deposited in fine granules on the optic disc and retina. In the rabbit it thus seems there are different currents at different levels in the vitreous. Close to the centre the current flows towards the lens; near the retina the current flows towards the optic disc. On section the sheath of the optic nerve is seen to be stained blue as are also the /

the intercellular spaces around the sclerotic, and the capsule of the lens. The retina is dotted over with minute granules of a dark blue tint. 52

The following is the ophthalmoscopic appearance of the fundus two weeks after an injection of pyoktannin.

a = patches where pigment has accumulated showing choroiditis.
v = vessels congested.
c = optic cup stained blue.
d = optic disc with congested capillaries.

H.W.C. W.S.

Action of Pyoktannin -

You will notice the retina covered over with minute granules. The larger brown patches each with a greyish centre, are the places where the retina and choroid were found adherent. Here some Choroido-retinitis had /

had set in, firmly uniting the retina and choroid with bands of fine fibrous tissue. The cup of the disc was stained blue and numerous granules were deposited on the nerve fibrils.

Histologically the retina was found to have undergone little change except at patches where choroido-retinitis was present. Here a great amount of pigment was deposited. Pyoktannin in the vitreous is a very mild antiseptic. In weak solutions it has scarcely any action beyond its staining power. In strong solutions it gives rise to optic neuritis and choroido-retinitis.

EXPERIMENTS with CAMPHORATED NAPHTHOL.

This is prepared (11) by mixing 100 grammes of β naphthol with 200 grammes of camphor and gradually heating the mixture till complete fusion occurs. In 1888, Reboul(35) published his well-known paper on the /

the treatment of tubercular synovitis by means of injections of camphorated naphthol. Since then, Perier[36], Senn[37] and others[38], have confirmed his experiments. According to these observers the injection of it was never followed by violent local re-action. Senn[37] recommends the addition of Iodine to this mixture in the proportion of 10 parts to 100. He further states that 50-100 grammes can be injected into a joint without producing any toxic phenomena. As camphorated naphthol produces so little irritation, I thought it would be an excellent antiseptic for the vitreous; I therefore injected two cub. mil. into the vitreous of two rabbits. The pupil at first was unaffected, but in the course of an hour contracted, the vessels also contracted but then dilated and remained so, through the ophthalmoscope the globule of naphthol could be seen. On the following day there was oedema of the eyelids, with a thick muco-purulent secretion /

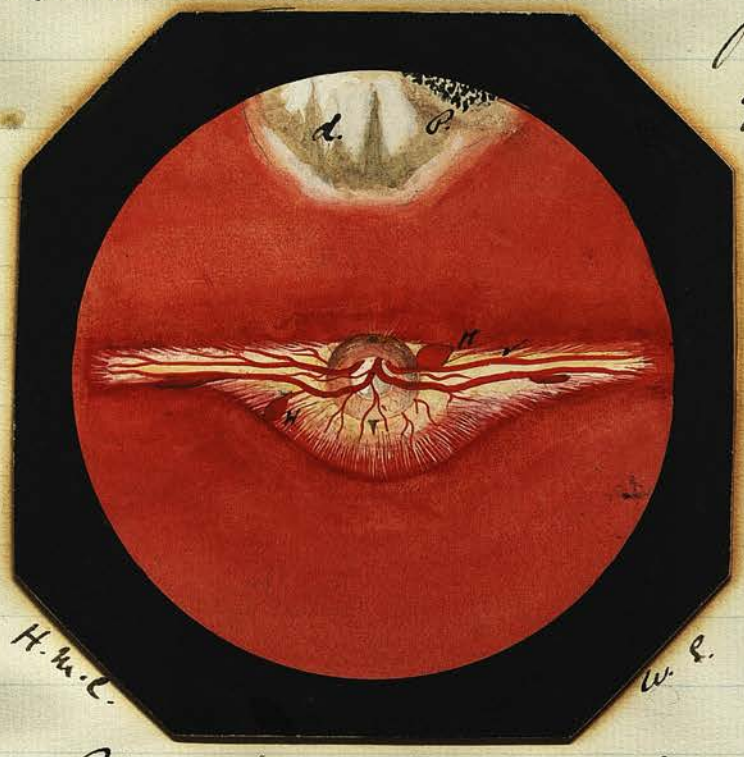
secretion, the iris had flakes of lymph deposited on its surface, and the lens was opaque. On the 4th day the oedema of the eyelids began to subside. The eye was found completely disorganised and shrunk. The following will show you the condition of the eye.

V = Vitreous
R = Retina a mass of small round cells.
C = Choroid greatly thickened with distended vessels
P = pigment of Choroid arranged in heads
S = Sclerotic -

L. P x 50. Camphorated Naphthol -

The retina is infiltrated with small round cells, and all its nerve cells have disappeared. Behind it you will notice a mass of fibrin threads studded with small round cells, the choroid is about 5 times its normal thickness; the chorio-capillaries being enormously /

enormously dilated, the retina, choroid and sclera are all firmly united together. The following is the ophthalmoscopic picture of another eye 4 hours after an injection of camphorated naphthol.



Camphorated naphthol.

You will notice at point of injection that the retina is detached. The vessels and capillaries are greatly dilated. A few capillaries have newly ruptured and blood is extravasated around them, in small circular, well defined areas about the size of a pea. This eye also became disorganised 12 hours after. As an antiseptic /

antiseptic, camphorated naphthol acts very satisfactorily but its powerful irritant properties make it unsuitable for ophthalmic practice.

EXPERIMENTS with a 10 p.c. EMULSION of IODOFORM in GLYCERINE.

Its action as an antiseptic is so well known as to require hardly any comment here. It has been injected into tubercular joints by Billroth(40) and Mikulicz(41) with very good results. Mazzoni(42) believes that it arrests completely all tubercular lesions. The experiments of Troje and Taugl(43) and lastly those of Gosselin(44) on rabbits, confirmed this fact.

I injected 2 c. mil. of 10 p.c. emulsion. This is the one usually recommended by the above observers. The ethereal solution, it appears, causes gangrene around the tissues(45), and besides, in the vitreous, would be worthless, on account of its coagulating properties /

properties.

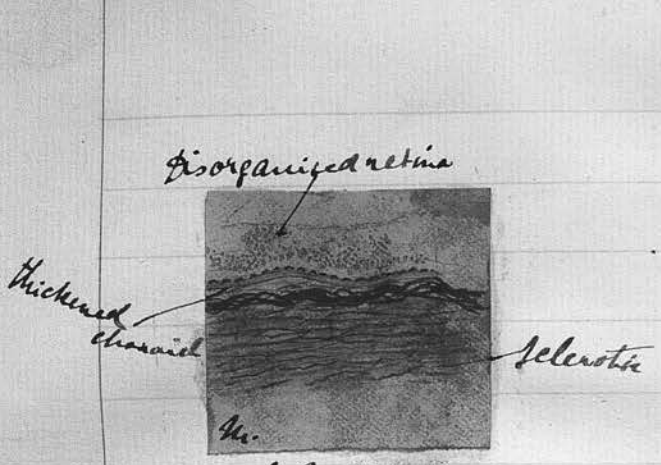
Two cub.mil. were injected. The pupil remained normal. The vessels contracted to fine threads and remained so for about one hour. About 4 hours after, the lens began to show signs of becoming cataractous; it became hazy first at its posterior pole, the haziness spreading towards its periphery. On the third day the lens was wholly opaque. There was no sign of any irritation. The glaucoma lasted for 8 hours. The vessels then began to dilate but no capillary haemorrhages occurred. The vitreous at the point of injection had a milky appearance. The particles of Iodoform could be seen with the ophthalmoscope floating in the vitreous and reflecting light very brightly. On the second day the retina was studded with small round reddish particles about the size of a millet seed, around them the retina showed signs of acute inflammatory reaction. The following shows the appearance presented.

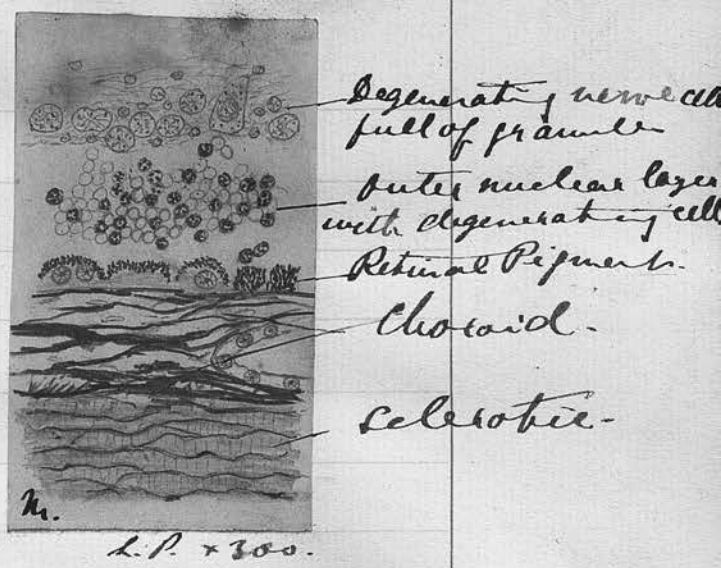
H = minute haemorrhage of a chocolate colour.
V = Congestion of vessels.
d = optic disc congested.

Action of Iodoform.

These small reddish spots appear to be the place where Iodoform particles have been deposited. Here the retina was found disorganised on microscopic examination, but not adherent to the choroid, though the latter showed signs of acute inflammation.

The following will give you an idea of the condition of the retina and choroid at one of those patches.





With low power the retina is seen to be transformed into a mass of small round cells. The choroid is thickened & the choroido-capillaries congested. With the high power the nerve cells are seen to be degenerated and full of granules, the choroidal vessels dilated, and the choroid firmly adherent to the sclerotic.

As an antiseptic, Iodoform in the vitreous has a very uncertain action. In two cases it checked the growth of the staphylococcus; in two it delayed it for three days; and in four cases it had no action on it. The cataract caused by this injection is due to the hygroscopic action of the Glycerine and not to the /

the Iodoform. When glycerine alone is injected into the vitreous, the lens becomes opaque in the same fashion and in about the same time. Rabbits kept for 6 weeks showed no change in the condition of the lens; if anything, the cataract seemed to have become denser.

EXPERIMENTS with BORACIC ACID.

When 4 cub. mil. of a 10 p.c. solution are injected in the vitreous, there is little inflammatory re-action. This solution acts very much like distilled water. When the same quantity of a 20 p.c. solution (14) is injected, there is slight retinitis with contraction of pupil and glaucoma which lasts for 10 hours. At point of injection the retina is found adherent to the choroid but nowhere else. When the staphylococcus is injected in the vitreous, a 20 p.c. solution stops its growth for two days. By repeated injections I succeeded in one case, out of nine, in checking /

checking its growth completely. Unfortunately these repeated injections cause shrinkage of the eyeball or lead to violent inflammatory re-action with haemorrhages in the vitreous.

EXPERIMENTS with PEROXIDE of HYDROGEN.

In the archives of ophthalmology Dr.Maklakoff(39) claims for it a very penetrating action as an antiseptic owing to its easy decomposition. He has used it most successfully in cases of corneal ulcers, hypopyon keratitis and allied conditions,and found that it produced very little irritation. I injected 2 c. mil. in the vitreous of 3 rabbits. The pupil at first contracted, but 10 minutes later it assumed its normal appearance and then dilated. At the point of injection a bloody, frothy secretion escaped. On examination the vitreous presented a silvery appearance caused by the numerous highly refractile globular /

globular bodies, the bubbles of oxygen. The blood vessels were enormously dilated, about 4 times their normal size, the disc being scarlet in colour. There was no inflammation of the iris or conjunctiva. The silvery appearance of the vitreous subsided on the 5th day and the retina presented a very peculiar aspect.

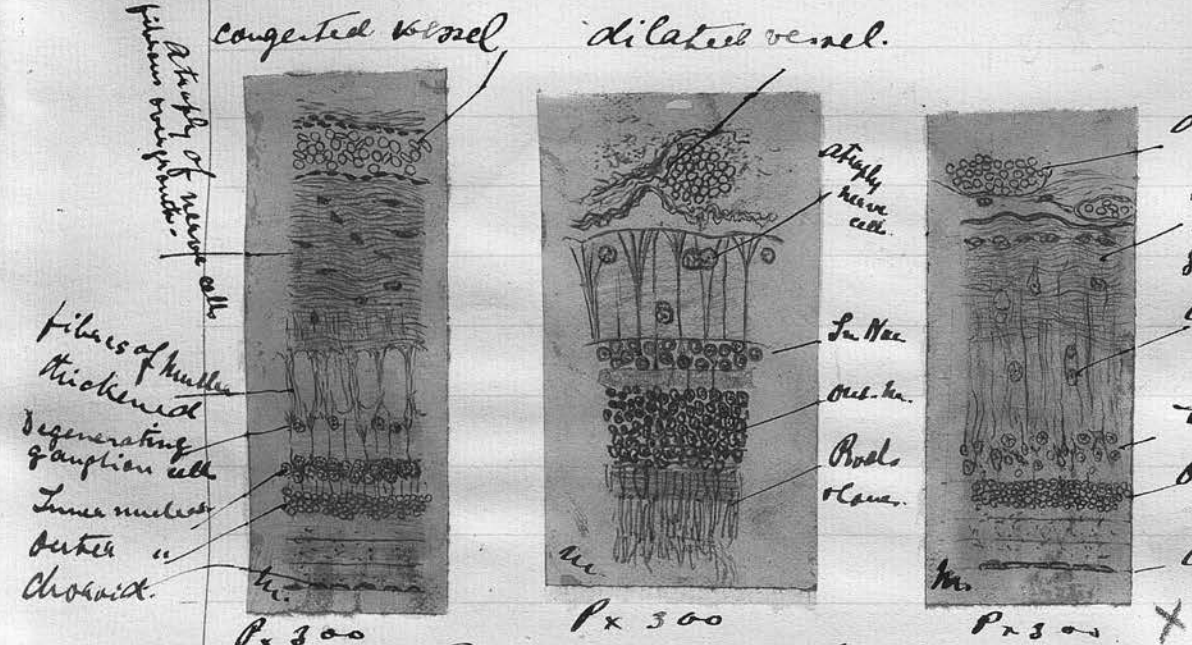
P = Patches of accumulated pigment showing choroiditis
a = Scattered pigment granules surrounding opaque fibres
v = dilated vessels
d = congested disc
c = capillary haemorrhage

Action Peroxide of Hydrogen.

All round the optic fibres there was a ring of pigment deposited irregularly. Beyond this were patches of pigmentation arranged irregularly and round them a whitish /

whitish area. The choroidal vessels could be seen shining through these patches.

Histologically you will notice the disappearance of the nerve cells and the great increase of the fibrous elements of the retina.



Peroxide of Hydrogen.

The blood vessels are dilated and full of blood and the choroid is normal in structure. There was no adhesion between the retina, the choroid and the sclerotic. As an antiseptic, peroxide of Hydrogen acts admirably in the vitreous. It checks the growth of the /

the pyogenes aureus and leaves very little opacity behind it, but its action on the pigment of the retina and choroid renders it unsuitable for injection.

EXPERIMENTS with a 1 p.c. SOLUTION of CREOLIN.

It has been used with good results as an antiseptic by Esmarch, Eisenberg and others. Galezowski used it as an eye wash in cases of ulceration of the cornea and other affections of the eye.

I injected 2 c. mil. into the vitreous and the pupil immediately contracted. The vessels became like fine threads and the capillaries could not be seen, so much had both contracted. There was slight irritation at first, but on the 3rd day iritis set in, with a copious secretion of flakes of lymph, completely blocking the pupil; oedema of the eyelids with mucopurulent secretion followed this. When the inflammatory re-action had subsided the eye was very much shrunk /

shrunk. Creolin when introduced along with the pyogenes aureus does not prevent its growth though it checks it for two days.

EXPERIMENTS with EUCALYPTOL and OTHER OILS.

As an antiseptic its properties are well known. I injected it in the vitreous, not in the hope of obtaining any striking results, but in order to see how antiseptic oils acted on it. Besides eucalyptol, I experimented with carbolic oil, oil of cloves, and turpentine. (16) All have pretty well the same action. Two cubic mil. were introduced in the vitreous. The pupil was not affected. The glaucoma caused by this injection never passed off till the whole eye became disorganised. On examining with the ophthalmoscope the oil globule could be distinctly seen with an area of haziness all round it. The vessels had not altered their calibre. On the second day there was great /

great oedema of the eyelids. The cornea had a ground glass appearance. The pupil was pin-pointed and the iris had flakes of lymph deposited on it. The haziness around the oil globule had spread through the vitreous. The vessels were congested and the fundus had a scarlet appearance.

v = vessels dilated.
c = capillaries "
d = congestion of optic disc.

H. M. C. W. S.

Action of Eucalyptol (second day).

On the 3rd day no reflex from the fundus could be got. The oedema was passing off and the inflammatory symptoms were disappearing. On the following day the /

the lens was beginning to get opaque. On the 6th day the cataract was complete and then the eye began to shrink. The following is the histological appearance.

The retina for the most part has completely disappeared and is replaced by small round cells. The choroid is represented simply by a line of pigment, the rest of the eye being a mass of leucocytes and fine fibrin threads.

When the pyogenes aureus is introduced in the vitreus none of the above oils check its growth.

EXPERIMENTS with OXYCYANIDE of MERCURY.

This antiseptic has been used by Galezowski(49) for /

for various septic and purulent affections of the eyes. Being alkaline it is said to be well borne by the tissues. I used a solution of about 1-500 and injected 2 cub. mil, the pupil contracted immediately and the vessels of the fundus were scarcely visible so much had they contracted. About 4 hours after, a sharp inflammatory re-action followed, the vessels dilating so much that the disc appeared one mass of blood. At the point of injection there was one dense white opacity which rapidly spread through the whole vitreous preventing any further ophthalmoscopic examination. All signs of inflammation, however, disappeared on the 3rd day, but the vitreal opacity became denser every day. On examining the eye a fortnight after, the retina looked healthy but was not adherent at any part except at the point of injection. As an antiseptic it acts very well in the vitreous, completely checking the growth of the pyogenes /

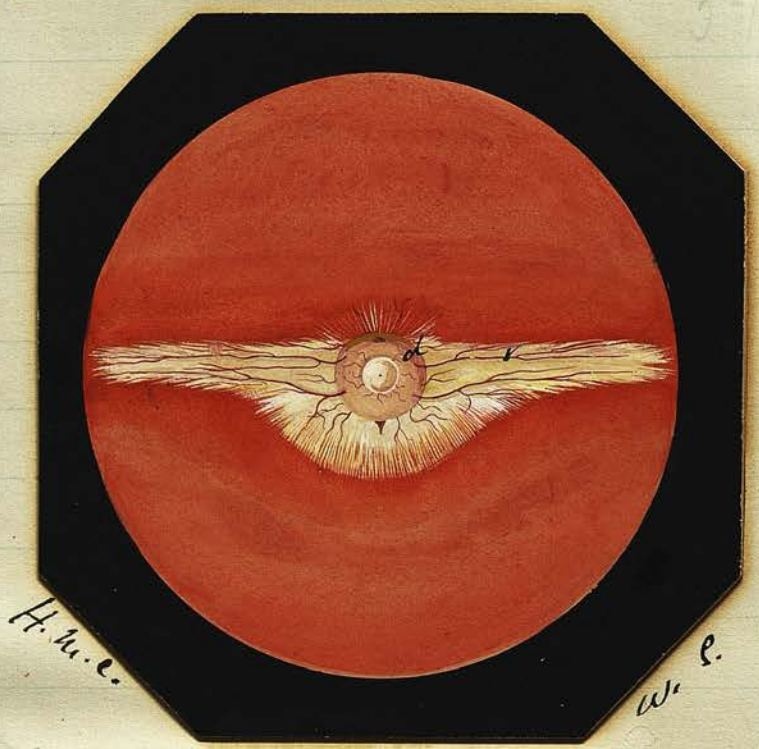
pyogenes aureus, unfortunately it causes such dense opacities in the vitreous as to be a useless substance.

EXPERIMENTS with CHLORINE WATER.

As an antiseptic aqua chlori has been used extensively for purulent affections of the eye. Von Graefe used it in preference to any other as it did not occasion the least irritation of the conjunctiva. The experiments of Schmidt-Rimplen(50) show that aqua chlori is the most powerful and at the same time the least irritant of antiseptics. According to this observer chlorine water produces disinfection of pus instantaneously, whilst a solution of corrosive sublimate 1 in 5000 disinfects it at the expiration of 10 minutes. The aqua chlori contains about 4 p. c. of Chlorine.

I injected two cubic mil. into the vitreous. The pupil contracted but soon assumed its normal aspect /

aspect. On ophthalmoscopic examination the vessels were found contracted and the vitreous had a



v = vessels very much contracted
d = disc pale & yellowish looking

Action of Chlorine Water.

peculiar yellow tint. At the point of injection no signs of irritation could be noticed. On the second day the eye assumed its normal aspect. In the vitreous the point of injection was surrounded by a thin, white line through which the vessels could be plainly seen. On the 5th day this milkiness at point of injection was scarcely perceptible. On the 8th day the vitreous /

vitreous showed nothing abnormal. The experiment was repeated four times with the same result. On examining the eyes post mortem no change could be seen in the retina except its usual attachment to the choroid at the point of puncture. The vitreous was clear, the lens, iris and choroid were perfectly healthy.

When the pyogenes aureus was injected in the vitreous, chlorine water checked its growth.

Towards the beginning of March, Mr.George Berry injected chlorine water into the vitreous of a patient with commencing suppuration caused by a thorn that had accidentally lodged itself in it. Immediately after the injection the patient felt a good deal of pain which disappeared in the course of the afternoon. The glaucoma passed off 3 hours after. On the following day the eye did not show any signs of irritation and the patient felt it much easier. About 5 days after the injection was repeated with the /

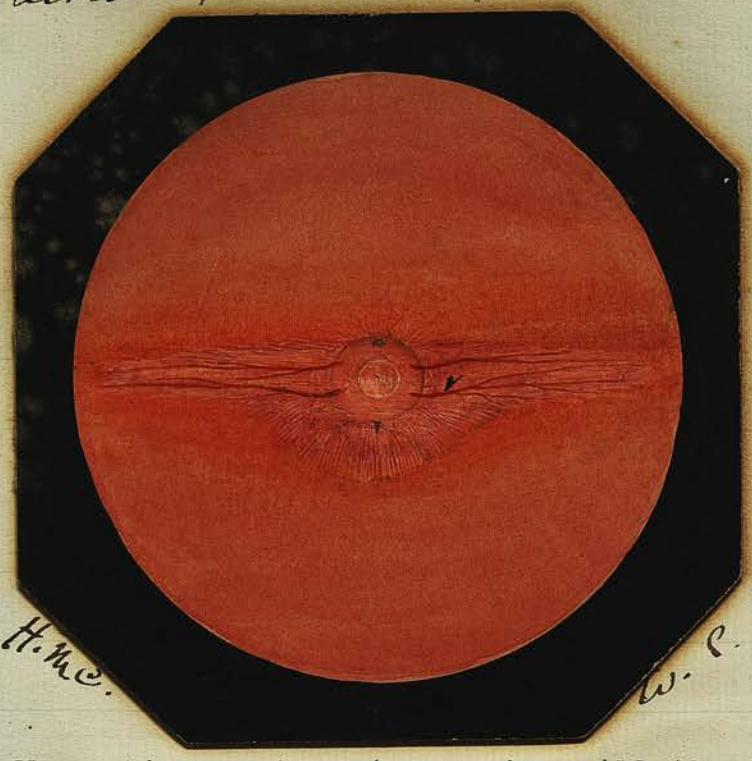
the same result. The patient was discharged a week after and was to have come back in a month, but unfortunately has not turned up since. The patient suffered from traumatic cataract, hence the condition of the retina could not be ascertained with the ophthalmoscope.

(6)

EXPERIMENTS with TINCTURE of IODINE.

Injected 2 cub. mil. into the vitreous of 3 rabbits. Immediately after, a reddish cloud spreading from the point of injection passed through the vitreous, completely screening the disc and the retinal vessels. Four hours after, this cloudiness began to disappear and active retinitis set in with great congestion of the retinal vessels. The disc and the opaque portions of the retina were of a scarlet colour. This is the ophthalmoscopic picture taken at the time.

Action of Tincture of Iodine -



r = vessels that seen through cloud caused by the injection -

The inflammation went on increasing till the 4th day and then began to subside leaving dense opacities in the vitreous which began gradually to get absorbed. Three weeks after there were still numerous opacities in the vitreous. This is the ophthalmoscopic picture taken from one of the animals.

P = Patches of choroidal atrophy deeply pigmented

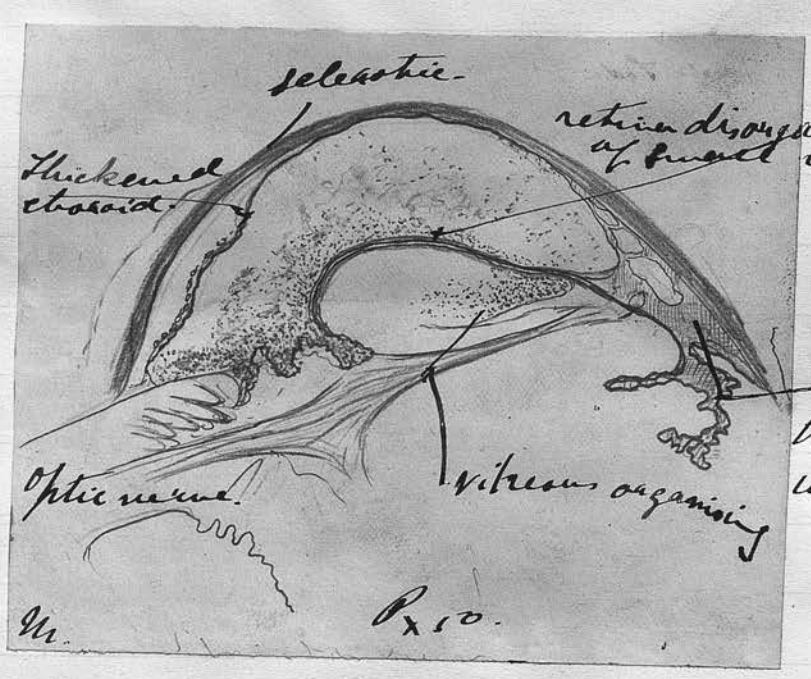
r = vessels smaller than usual

c = capillaries few & atrophied -

d = disc pale -

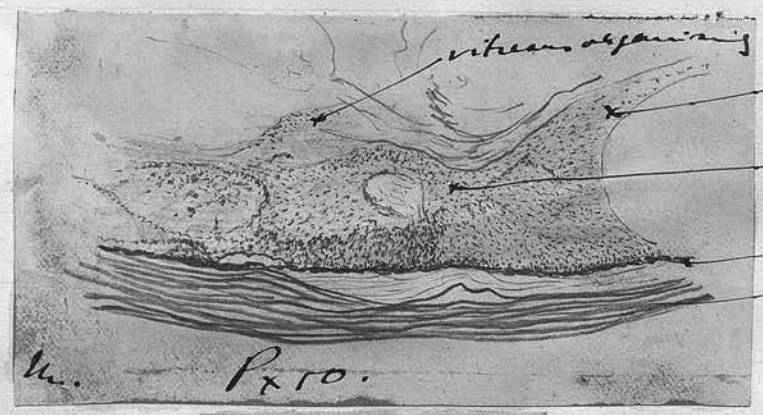
Action of Tinct. of Iodine -

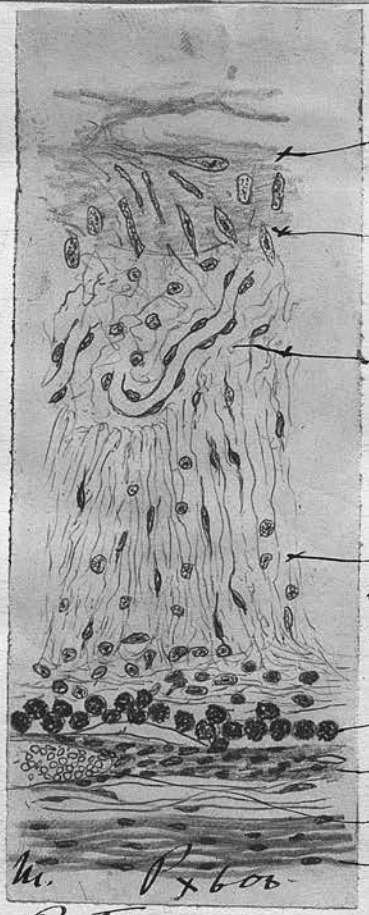
At the point of injection you will notice a large atrophic patch deeply pigmented. Here the retina was transformed into cicatricial tissue as was discovered afterwards with the microscope. The choroid was greatly thickened; there was a fine fibrillary network in the chorio-capillary layer, the interstices of which were full of pigment.



Besides that large atrophic patch, two smaller ones can be seen close to the periphery of the lower quadrant. The disc and the opaque optic nerve fibres had assumed a yellowish colour. The vessels were, if anything, smaller than usual and the capillaries were atrophied /

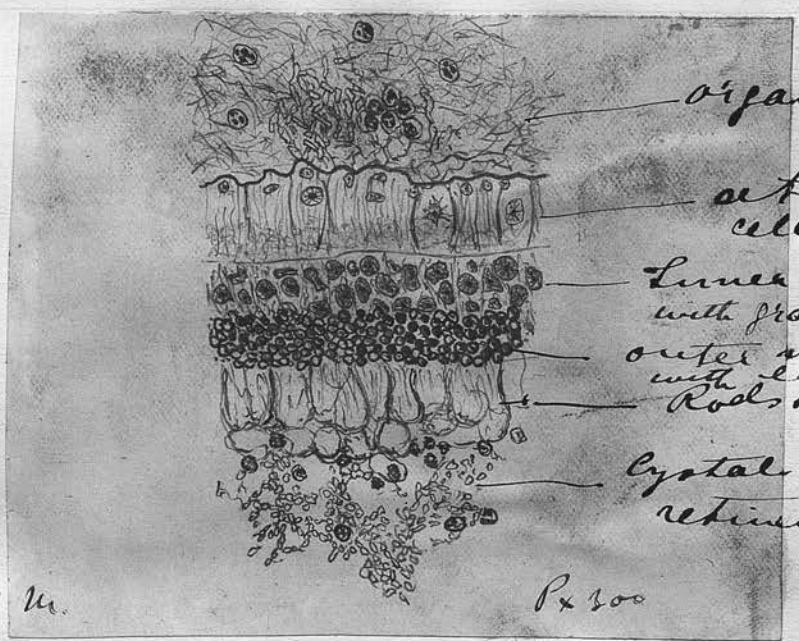
atrophied, many of them having disappeared. The whole fundus was of a light chocolate colour. On examining the optic disc microscopically, active optic neuritis was found to be present. The ganglion cells





Section of Retina near optic disc.

had disappeared or were atrophied. The nerve fibres were degenerated and full of fat globules. The choroid was thickened and its pigment greatly increased. The retina near the disc showed degeneration of all

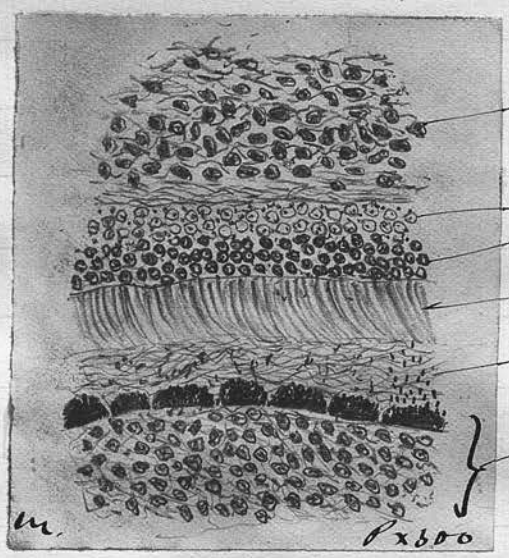


its nerve elements. Between it and the choroid there was a large exudation of leucocytes. The vitreous next to it was organising, and was closely adherent to it. A few large multinucleated cells were found entangled amongst the fibrin threads.

EXPERIMENTS with IODISED SERUM.

As /

As tincture of Iodine produces such a violent re-action, I though that Iodised Serum or the liquor Iodi, whilst possessing the same beneficial properties as tincture of Iodine, might possibly produce a less severe inflammation. Accordingly I injected 2 cub. mil. into the vitreous of 3 rabbits and found that the local re-action produced by it did not spread, but remained localised to the point of injection. The retina at the point of injection was found adherent to the choroid. Its ganglion cells had atrophied and



its other layers were infiltrated with small, round cells. The choroid was thickened and its pigment greatly /

greatly increased.

The rest of the retina and choroid showed no changes microscopically. Iodised serum seldom causes cataract whilst it seems to be the rule with tincture of iodine. Iritis, and conjunctivitis with a copious muco-purulent secretion often accompany the injection of the tincture, but seldom appear with either the liquor or the iodised serum. As both produce adhesion of the retina to the choroid, iodised serum is much preferable, seeing that its action is much more localised to the spot of injection and its inflammatory re-action is very much less. As antiseptics both act in very much the same fashion checking the growth of the pyogenes aureus.

In addition to the above experiments with antiseptics, I tested the actions of the following substances :-

(17)

Hydrochlorate of Cocaine. When 2 c. mil. of a 4 p.c. solution are injected in the vitreous the pupil rapidly dilates and remains so for more than 8 days. This dilatation of the pupil persists after the enucleation of the eye. The vessels of the fundus on the other hand, contract to mere threads, as soon as the injection is made, but between the second and third days they dilate to about 3 times their normal size. There is no active retinitis at any time and the vitreous remains clear. About ten days after the injection the animals usually begin to lose the hair over the supra orbital region. Two of the rabbits died during this time from convulsions but it is doubtful if they were caused by the injection. Cocaine may safely be injected in the vitreous without causing disorganisation /

disorganisation of the retina or opacity of the vitreous. A solution of Sulphate of Atropin 4 grains to the ounce has almost the same action as the above. The pupil dilates and remains so after the enucleation of the eye. If now two minims of a 4 p. c. solution of eserine be injected in the vitreous the pupil immediately contracts. Like cocaine, atropin contracts the blood vessels of the fundus to mere threads, this is then followed by enormous dilatation. It leaves no opacity in the vitreous and has scarcely any visible action on the retina, it may therefore be safely introduced into the vitreous.

When 2 c. mil. of 4 p. c. solution of Sulphate of Eserine (18) are injected into the vitreous the pupil contracts almost instantaneously and remains so for 10 days. This contraction persists after the enucleation of the eye, and atropin has no power to bring about its dilatation. The retina and the vitreous showed /

showed no inflammatory changes, but in two cases iritis followed the injection. The tension of the eye was increased on the first day, but then it assumed its normal proportion and never became minus. The blood vessels of the fundus were dilated for the first two days; then they assumed their normal calibre.

Injected 2 c. mil. of the injectio ergotini hypodermica.(20) The pupil at first contracted and then slightly dilated. The blood vessels of the fundus were so much contracted that only their origin could be made out ophthalmoscopically. This contraction persisted for 5 days. The vitreous remained clear and the retina showed no sign of active inflammation. Out of ten experiments, two got iritis with complete blocking of the pupil, one developed gangrene of the upper eyelid and cataract followed two others. Abadie recommends the injection of ergotin for cases of haemorrhagic glaucoma, but has never tried it as yet /

yet.

Nitrate of Pilocarpin has been used extensively as a hypodermic injection in cases of detachment of the retina. When 3 c. mil. of a solution of 5 grains to the ounce are introduced into the vitreous, the pupil immediately contracts and the blood vessels of the fundus dilate so much that the disc is completely hidden by them. At the same time the vitreous becomes hazy and the tension of the eye becomes slightly increased, the vessels of the fundus begin to assume their normal calibre at the end of a week. The retina on microscopic examination is infiltrated with small round cells; but is not found to be adherent to the choroid at any point. Out of 8 experiments iritis occurred in four, cataract in two, three weeks after the injection.

In conclusion I must ask you to bear in mind that all these experiments with the single exception of /

of chlorine, have been performed on rabbits. How far they may be applicable to man it would be difficult to say.

In rabbits the regeneration of the vitreous is wonderfully quick (22) and persistent glaucoma leading to disorganisation of the eye, seldom if ever occurs.

Again, though the pyogenes aureus was injected into the vitreous over fifty times, in no case did sympathetic inflammation (24) affect the opposite eye, so long as the latter had not been the seat of a recent inflammation, or had not been injured subsequently.

The idea of causing a localised adhesion of the retina to the choroid by inducing a moderate degree of inflammation in the former, has not been successful in practice.

Slight degrees of retinitis can easily be produced, they are usually accompanied by a sub-retinal effusion; when this effusion gets absorbed adhesion between /

between the retina and choroid never ensues in rabbits.

In severe forms of retinitis caused by powerful irritants we certainly get adhesion of the retina to the choroid but with complete disorganisation of the former extending for a considerable distance from the point of injection.

In all forms of inflammation of the retina the nerve cell layer is the first affected and suffers most. The external granular layer is the last to disappear. None of the 7 layers are ever reproduced once they have been destroyed.

As antiseptics for the vitreous, corrosive sublimate and carbolic, owing to their stable compounds with albumen, and the inflammatory re-action which they produce, are not so useful as some other less active ones. Tincture of Iodine, camphorated naphthol, hydronaphthol, eucalytol and other antiseptic oils are far too violent in their action and cause disorganisation /

disorganisation of the eye. Boracic acid and Iodoform are weak and non irritant antiseptics. Chlorine water is a powerful antiseptic and produced little inflammatory re-action. Oxycyanide of Mercury and Peroxide of Hydrogen are just as good as chlorine, but the former causes opacities in the vitreous and the latter seems to bleach the pigment of the eye. Creolin is a powerful irritant and its antiseptic action is very doubtful. Pyoktannin does not act as an antiseptic in the vitreous; it gives rise to neuritis with subsequent degeneration and atrophy of the optic nerve.

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